CLAIMS

WHAT IS CLAIMED IS:

1. A battery charger that is modular and reconfigurable and provides flexible, multi-port rapid charging, and selectable output capabilities, the battery charger comprising:

base modules providing DC power charging voltage, each base module of the base modules including a power converter and providing output voltage for charging a battery, wherein each base module includes an intermediate high frequency transformer; and

a master controller that interfaces with the base modules to regulate power delivered by each base module.

2. The battery charger of claim 1, wherein the base modules further comprise an inverter and a rectifier.

3. The battery charger of claim 2, wherein the base modules further comprise a slave microprocessor controller with which the master controller communicates in a call and response communication format.

4. The battery charger of claim 3, wherein the slave microprocessor controller sets current and voltage commands based on communications from the master controller.

5. The battery charger of claim 3, wherein the master controller auto-configures current and power rating of the charger based on the number of base modules connected and detected.

6. The battery charger of claim 5, wherein the auto-configuration operation comprises an enumeration procedure that determines how many base modules are connected.

7. The batter charger of claim 5, wherein the inverter comprises a single switch.

8. The battery charger of claim 5, wherein the inverter comprises four switches.

9. The battery charger of claim 2, wherein the inverter comprises a full bridge.

10. The battery charger of claim 2, wherein the inverter comprises two switches.

11. The battery charger of claim 2, wherein the inverter comprises a half bridge.

12. The battery charger of claim 2, wherein the inverter comprises a half bridge.

13. The battery charger of claim 2, wherein the rectifier comprises a full wave rectifier.

14. The battery charger of claim 2, wherein the rectifier comprises a push-pull rectifier.

15. The battery charger of claim 1, further comprising a current mode controller for each of the base modules, wherein the current mode controller regulates output current based on a command set from the master controller.

16. The battery charger of claim 15, further comprising a voltage mode controller for each of the base modules, wherein the voltage mode controller regulates output voltage based on a command set from the master controller.

17. The battery charger of claim 16, further comprising a droop sharing control for each of the base modules that ensures current sharing between base modules.

18. A battery charging system comprising:

a modular power stage configured to receive an alternating current (AC) input and provide a direct current (DC) output for charging a battery, the modular power stage comprising:

an inverter coupled to a rectifier circuit, the inverter having as its input an input voltage, the rectifier circuit having as its output a battery charging voltage;

an intermediate high frequency transformer intermediate the inverter and the rectifier to convert alternating current (AC) voltage from the inverter to a lower voltage input to the rectifier;

a current mode controller coupled to the output of the rectifier circuit and provides a current control signal for the modular power stage;

a voltage mode controller coupled to the output of the rectifier circuit and provides a voltage control signal for the modular power stage; and

a droop sharing control that ensures current sharing between a plurality of modular power stages under constant voltage operation; and

a system controller that interfaces with the modular power stage and regulates power delivered by the modular power stages.

19. The battery charging system of claim 18, wherein the switching circuit is controlled by a pulse width modulation (PWM) controller.

20. The battery charging system of claim 18 further comprising relays coupled to the output of the plurality of modular power stages to control output thereof.

21. The battery charging system of claim 18 wherein the system controller configures the plurality of modular power stages depending on battery charging needs.

22. A modular and reconfigurable battery charger having rapid charging capabilities, the battery charger comprising:

(a) means for receiving an AC voltage and providing an output voltage to charge a battery, wherein the means for receiving an AC voltage and providing an output voltage comprises a means for transforming a high frequency AC voltage to a lower voltage;

(b) means for controlling output current based on a current command set;

(c) means for controlling output voltage based on a voltage command set; and

(d) means for controlling multiple means for providing an output voltage to charge a battery, wherein the multiple means for providing an output voltage to charge a battery are coupled in parallel.

23. The battery charger of claim 22, further comprising means for controlling droop based on the output current to ensure current sharing between a plurality of modular power stages under constant voltage operation.

24. The battery charger of claim 23, wherein current sharing includes utilizing a highest current technique.

25. The battery charger of claim 23, wherein current sharing includes utilizing an average current technique.

26. The battery charger of claim 22, further comprising relays coupled to the multiple means for providing an output current to charge a battery.

27. A method for charging batteries using a plurality of modular battery chargers, the method comprising:

receiving an indication that a first battery is connected to a first base module;

if one or more batteries other than the first battery are connected to one or more base modules other than the first base module, performing the operations of:

(a) closing output relays of all base modules with batteries connected;

(b) identifying a base module with lowest discharged battery;

(c) closing the parallel relay of the base module with the lowest discharged battery;

(d) closing parallel relays of all base modules with no batteries connected;

(e) configuring base modules with closed parallel relays for parallel operation;

(f) setting up remaining base modules as stand alone chargers; and

(g) loading charging parameters into the base modules;

if no other batteries other than the first battery are detected as connected to one or more base modules, performing the operations of:

(a) closing an output relay of a base module with lowest discharged battery;

(b) closing all parallel relays to the base modules;

(c) configuring the base modules for parallel operation; and

(d) loading charging operations into the base modules;

starting a charging cycle.

28. The method of claim 27, wherein if a change in battery connections is detected before a charge cycle is completed, saving a last charge state and stopping charging.